AbstractID: 10286 Title: A Planning System for Dynamic Gamma Knife Radiosurgery

Purpose: To develop a prototype planning system for dynamic Gamma Knife radiosurgery.

Method and Materials:

Dynamic Gamma Knife is a new concept for implementing Gamma Knife radiosurgery. It uses the spherical high dose volume created by the Gamma Knife unit is as a 3D "paintbrush", and treatment planning becomes routing the "paintbrush" to "paint" a 3D tumor volume. We have recently finished developing an inverse planning system for dynamic Gamma Knife radiosurgery. Our planning system is a "turn-key" solution, where the inverse planning problem is solved as a traveling salesman problem combined with constrained least square optimizations. Its input parameters include: (1) contoured anatomy and prescriptions, (2) desired delivery time, (3) APS (advanced patient positioning system) speed, and (4) amount of system memory available. The outputs include: (1) a control point sequence for the APS system together with shot configuration and beam-on times at each control point, and (2) dose distributions and DVH plots for each structures.

Results and Conclusion:

We have tested simulated cases that included a spherical tumor, a C-shaped tumor, and a C-shaped tumor surrounding a spherical critical structure. The results of these tests showed that: (1) dynamic Gamma Knife radiosurgery is ideally suited for inverse planning, where high quality radiosurgery plans with tight isodose distributions and sharp DVH curves can be obtained in minutes of computation; (2) dynamic radiosurgery plans are more conformal and uniform than current plans and have significantly shorter delivery times; (3) dynamic Gamma Knife radiosurgery can maintain steep dose gradient (around 13% per mm) between the target volume and the surrounding critical structures; (4) with dynamic Gamma Knife radiosurgery, one can obtain a family of plans representing a tradeoff between the delivery time and the dose distributions, thus giving the clinician flexibility in choosing a plan based on the clinical situations.